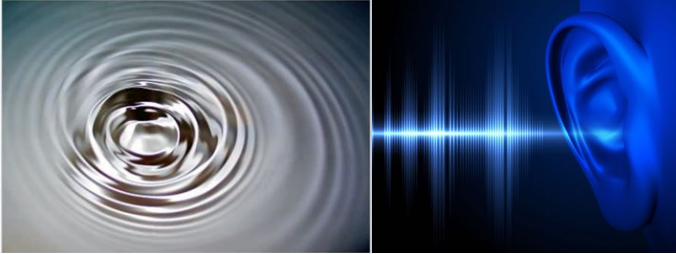


# EAS 4801 - Planetary Sound

## Lec#1: Introduction, basic principles

Dr. Zhigang Peng Spring 2020



## Today's Outline

- Introduction to the course
  - Class logistics, requirements and policies
  - Intro to your instructor
- Course goals and tentative plan
- A brief introduction of sound and wave propagation

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## Time and Place

- Lecture Time: M,W,F 12:20 pm – 1:10 pm
- Lecture Place: ES&T L1116

Class website:

<http://geophysics.eas.gatech.edu/classes/PlanetarySound/>

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## Course Goals

- For you:
  - To understand **physics of vibration** and **wave propagation**
  - To learn about various types **sources** (both natural and anthropogenic) on the Earth and other planets
  - To build **physical intuition** and **quantitative skills** to conduct scientific research

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## Expected class manners

- Classroom attendance is very important – quizzes at the beginning of some classes
- Ask me if something is not clear
  - You and your classmates will learn better
- Respect your classmates
  - Don't chat, rustle newspapers, use cell phones, etc. during lecture
  - Please arrive on time

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## Academic honesty

**General:** It is expected that all students are aware of their individual responsibilities under the **Georgia Tech Academic Honor Code**, which will be strictly adhered to in this class. For any questions involving these or any other Academic Honor Code issues, please consult me, or visit [www.honor.gatech.edu](http://www.honor.gatech.edu).

**Plagiarism:** Plagiarizing is defined by Webster's as "to steal and pass off (the ideas or words of another) as one's own: use (another's production) without crediting the source." **If caught plagiarizing, you will be dealt with according to the GT Academic Honor Code.**

**Homework:** When working on homework, you may work with other students in the class. However, you must turn in your own solutions, with the following written on it: your name, and the names of everyone you collaborated with. Late homework will not be accepted.

**Exams:** Reference to texts or other documents such as previous semester course materials during exams is strictly forbidden. Using these materials will be considered a direct violation of academic policy and will be dealt with according to the GT Academic Honor Code. The use of electronic devices (e.g. cellular phones, computers etc.) other than non-programmable calculators during exams and quizzes is not allowed.

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## Course Requirements

- 4 Homework (40% grade; 10% each)
- One exam (30% of grade; Date 1/29/2020)
- Course project and presentation (25% of grade; presentation date 2/7/2020, last day of class)
- Quiz (5%, during some classes)

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## Course outline

- Week 1: Basic principles of waves generation and vibrations.
- Week 2: Scientific devices for recording sounds and vibrations.
- Week 3: Basic tools available to analyze recorded time series.
- Week 4: Examples of recording sound/vibrations in natural and anthropogenic environment.
- Week 5: Recent new discoveries on recording vibrations/sounds on Earth and other planetary bodies. Student course project presentations.

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## Where to find me





- **Instructor:** Dr. Zhigang Peng
- ES&T 2256
- zpeng@gatech.edu
- 404-894-0231
- My office hour: M,W,F 1:10 – 2:00 pm, or by appointment

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## Dr. Zhigang Peng's background

- Undergrad.: University of Science and Tech. of China (USTC) 
- Graduate school: University of Southern California (USC)
- Postdoc: University of California, Los Angeles (UCLA) 



Age 7  
1/6/2020



Age 12



Age 25



Age 30

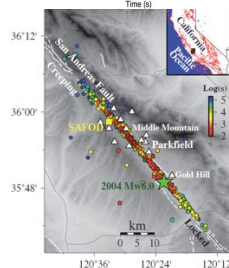
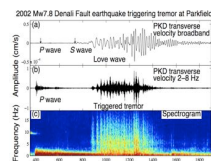


Age 43

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## My Research Interest

- Earthquake interaction
  - Remote triggering of earthquakes and tremors
  - Foreshocks, aftershocks, etc
- Earthquake detection
  - Template matching
  - Big data and machine learning
- Fault zone structures
  - Internal structures of the active fault zones
  - Temporal changes of fault zone properties



SCIENTISTS FIND 11 TIMES MORE AFTERSHOCKS FOR 2004 QUAKE

<http://geophysics.eas.gatech.edu/people/zpeng/>

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### Geophysics Faculty

- Felix Hermann: Geophysics, Seismic Imaging
- Andrew Newman: Earthquake and volcano geodesy and seismology
- Zhigang Peng: Earthquake seismology
- Winnie Chu (starting in fall 2020): Cryosphere, ice radar sounding
- Samer Naif (starting in fall 2020): Electromagnetic geophysics

### Planetary Science Faculty

- Britney Schmidt: Dynamics of icy moon, glaciology
- Sven Simon: Space Physics
- James Wray: Planetary Science, Astrophysics

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<http://geophysics.eas.gatech.edu/>

## Icebreaker



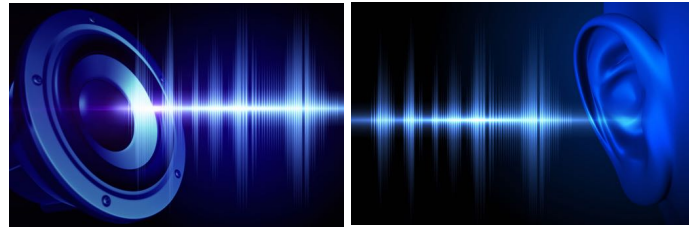
- Time to introduce yourself
- Your name
- Major/yr
- Background
- Why are you interested in taking this minimester class?
- Do you have any coding experience (Matlab, Python, Excel)?

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## What is sound?



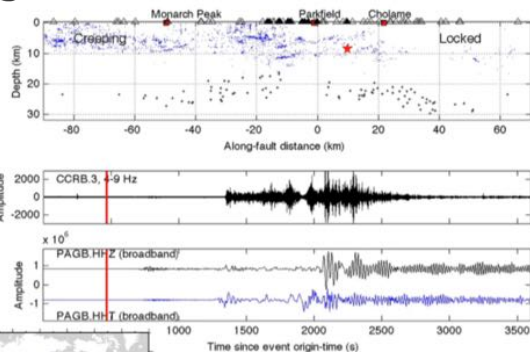
A vibration that travels through the air or another medium and can be heard when they reach a person's or animal's ear

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## What is this sound?



Listening to the 2011 Mw9.0 Tohoku-Oki Earthquake (Peng et al. SRL, 2012)

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## Wave



Surface waves in water showing water ripples

- a wave is a disturbance (change from equilibrium) of one or more fields such that the field values oscillate repeatedly about a stable equilibrium (resting) value.

**Is sound a wave?**

**Can you give a few examples of waves?**

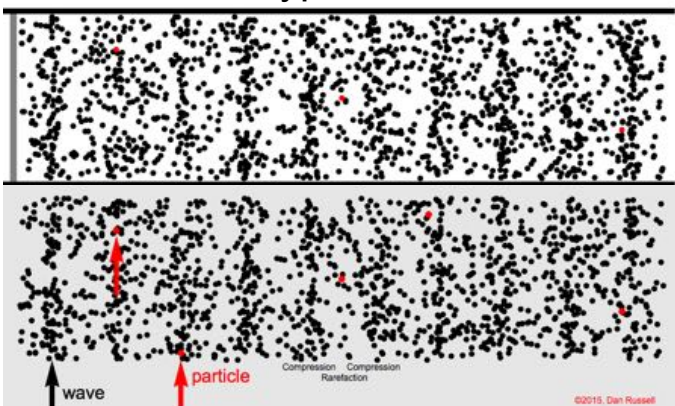
- Hydroacoustic waves
- Seismic waves
- Electro-magnetic waves

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## Two types of waves

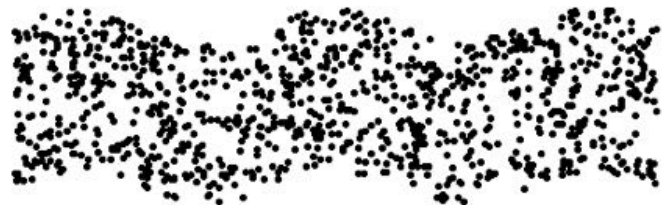


In a **longitudinal wave** the particle displacement is parallel to the direction of wave propagation.

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In a **transverse wave** the particle displacement is perpendicular to the direction of wave propagation.



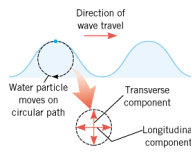
<https://www.acs.psu.edu/drussell/Demos/waves/wavemotion.html>

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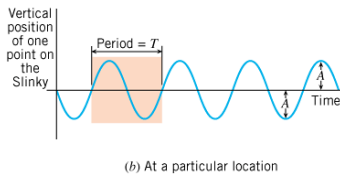
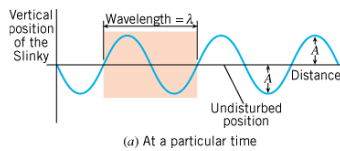
**Water waves** are an example of waves that involve a combination of both longitudinal and transverse motions. As a wave travels through the water, the particles travel in clockwise circles.



Direction of Propagation  
LOVE WAVE  
Particle Motion  
Love Wave (L-Wave) Animation

Direction of Propagation  
RAYLEIGH WAVE  
Particle Motion  
Rayleigh Wave (R-Wave) Animation

## Amplitude, Wavelength, and Period



The **amplitude**,  $A$  is the maximum disturbance.  
The **wavelength**,  $\lambda$  is the horizontal length of one cycle of the wave.  
The **period**,  $T$  is the time required for one complete up/down cycle of the wave.

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